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ABSTRACT

The study investigated the effects of practice on the mastery of two industrial arts skills (hammering and sawing). The major question asked was whether a film followed by practice leads to better mastery than a film presented without practice. The relationships among cognitive, affective, and psychomotor aspects of the task were explored. The subjects were 148 fourth to eighth grade boys and girls with no previous industrial arts experience. Students were randomly assigned to experimental and control groups and provided different types of instructional treatment. The students were given attitude and knowledge tests on the films they were shown and rated by experts on their skill performance; they were administered a battery of achievement, intelligence, and attitude tests as well as the Rod-and-Frame test, to identify their cognitive styles. Results are described by instructional treatment, by sex, and by level of intelligence. Correlations among knowledge, attitude, and skill performance are presented, as well as the factor analysis of the major variables in the study, and regression analysis. A summary of the results and their instructional applications are presented, with implications and recommendations. The groups that had practice had higher mean scores than the groups that just saw the film. (Author/AJ)

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FINAL REPORT

THE EFFECTS OF SELECTED INSTRUCTIONAL STRATEGIES ON LEARNING EFFICIENCY IN VOCATIONAL TECHNICAL EDUCATION PROGRAMS

PHASE II

CONDUCTED UNDER PART C OF PUBLIC LAW 90-576

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JUNE 30, 1975

FINAL REPORT

RESEARCH PROJECT

CONDUCTED UNDER PART C OF PUBLIC LAW 90-576

The project reported herein was performed pursuant to a grant from the Bureau of Vocational Education, Maine Department of Educational and Cultural Services. Grantees undertaking such projects under State Department sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions do not, therefore, necessarily represent official Department of Educational and Cultural Services position or policy.

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ABSTRACT

The study was designed to investigate the effects of practice on the mastery of two industrial arts skills. The major question asked was whether a film followed by practice leads to better mastery than a film presented without practice. Also the relationship between cognitive, affective and psychomotor aspects of the tasks were explored. Two skill areas were chosen: hammering and sawing. Two other films: A Safe Shop and Selecting Woods were utilized in the experiment.

A post-test only control group design was used to test the main hypothesis. Correlational analysis, step-wise multiple regression and factor analysis were used to investigate the relationships between the variables. The subjects were 148 fourth to eighth grade boys and girls in a school union in which there had been no previous industrial arts programs. Students were randomly assigned to experimental and control groups. The students were provided different types of instructional treatments. The students were given attitude and knowledge tests on the films they were shown and rated by experts on their skill performance on hammering and sawing. They were administered a battery of achievement, intelligence, attitude tests as well as given the Rod-and-Frame test to identify their cognitive style.

Results are described by instructional treatment, by sex and level of intelligence for the first set of research questions. Correlations between knowledge, attitude and skill performance are presented as well as the factor analysis of the major variables in the study and regression analysis.

A summary of the emperical results as well as the instructional applications of the results is listed. Implications for curriculum, teachers and administrators are presented. Recommendations for the State Department of Educational and Cultural Services, Pre-service and In-service Education for teachers, administrators, curriculum developers and additional research are given.

I. Definition of Problem Area:

Few research studies are available in the area of vocational education related to the application of principles of cognitive, psychomotor or affective learning. Knowledge of the learning process is vital to educators at every academic level in the selection of appropriate learning and teaching strategies leading to the most effective student mastery of skills and concepts. The AVA (1969) placed as one of its six research priorities the need to analytically investigate the "process" of vocational education. This organization also stressed the need to assess the "end products" of vocational education since such outcomes or objectives have not received adequate consideration nor have they been effectively defined and operationally delineated.

In Maine and other states there have been limitations in the hardware available for instructional purposes in most classrooms, shops and laboratories. This has led to the exploration of films, video tapes and other audio-visual techniques by teachers in the preparation and delivery of their instruction. Such developments have led learning specialists to investigate the use of media and various types of mediated instructional methods in an effort to identify those that are most effective in achieving instructional outcomes. The main strategy in the project was to design and conduct an empirical investigation to attempt to demonstrate the relative effectiveness of different types of instructional techniques.

II. Rationale and Justification

There are few studies available related to instructional methods and learning processes specific to vocational education. Simpson (1966) in a year long study of the classification of psychomotor objectives, recommended that more research was needed in the clarification of the psychomotor area as well as into its interactions with the cognitive and affective domains.

The research has centered primarily around the use of films since most schools have limited equipment and are more or less limited to the use of group instruction. Moeler (1967, 1968) found that films were not a sufficient substitute for individual demonstration but could be effective supplements to well-integrated instructional programs. Sommer (1970) reported that teacher plus film (single-concept loop) were more effective than teacher alone. Furthermore, the film-only group learned as much as the teacher-only group. He also reported that need for repetition and/or demonstration was substantially reduced with the films. Boys and girls did not differ significantly in their performance on any of the measures utilized.

These studies suggest that audio-visual aids such as films tend to be more effective under certain conditions than others. Little reserach has been conducted combining film and other audio-visual techniques with "hands-on" experiences which incorporate a practical "action" phase within the instructional sequence. The previous research studies mentioned as well as others do not typically use the subjects as their own controls, and also they usually utilize more than one task under different conditions.

GOALS AND OBJECTIVES OF THE PROJECT

The project had a number of specific objectives to be investigated. First of all, the effects of practice, "hands-on" experience, was studied in relation to typical industrial arts objectives. The question asked was whether a film followed by practice leads to better mastery than a film presented without practice.

Secondly, the relationship between cognitive, affective and psychomotor aspects of the task were explored. Two questions were asked: (1) What is the structure and relationship between the cognitive, affective and psychomotor variables related to success in the selected tasks and (2) What variables best predict performance of the psychomotor tasks selected.

In addition, the contribution of sex and level of intelligence to the mastery of these tasks was investigated.

Experimental Design

The experimental design utilized to test the major hypothesis of the study was a post-test only control group design. Students were randomly assigned to treatment groups by grade.

PROCEDURES

Sample

The sample selected for the study were 148 students enrolled in grades four through eight at the John R. Graham School in Veazie. The population was chosen because the school does not have any industrial arts program for the students in the upper grades. Experience, therefore, could be controlled through design and random selection. The Veazie-Orono school union had just received a Title III grant for establishing a program in practical arts -- Practical Arts through Community Helpers. The students were just about to begin on a carpentry unit and the films and experiences chosen related to the goals of the project.

Girls as well as boys were utilized in the experiment. Seventy-six of the sample were boys; 72 were girls. Thirty students were at the fourth, seventh, and eighth grade level while 29 participated at the fifth and sixth grade level.

Films

Four films were selected to be used for the experiment. It should be noted that in the original research proposal, the Department of Educational and Cultural Services had agreed to provide the films and objectives to be tested. Because of a number of factors and lateness in the project year, the project staff was given the task of selecting the films and objectives to be tested. The following procedures were used in selecting the films:

1) A review of behavior objectives for typical industrial arts programs was made.
2) The consultant for industrial arts from the Department of Educational and Cultural Services was contacted to provide information on available films and films commonly used by schools within Maine.
3) The staff reviewed the list of films for appropriateness, availability, and usefulness.
4) Six films were secured for preview. A panel of research staff members and school personnel selected four of the films for use in the experiment. These were:

   Hand Saws*

   Knowing Your Woods*

   Using Screws and Nails*

   Industrial Arts: A Safe Shop*

   The films rejected were Boring and Drilling Tools and Planes. These were not used because the tasks were too complicated for naive subjects and more specialized equipment was needed to conduct the testing.

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*Young America Films

Experimental Procedure

Two different instructional treatments were utilized. Students were shown the two performance films and then groups either given hands-on experiences or immediately tested without any practice. The "hands-on" experience or laboratory experiences were directed by union carpenters.

The performance ratings were made by the three carpenters. They were asked to view the film and the rating procedures were discussed with them prior to their work with the students.

The four through six experimental group had a discussion of wood and shop safety prior to taking the knowledge tests. All other students took the knowledge and attitude tests for each of the four tasks after the films were shown.

Criterion Tests

For each of the four films used a knowledge test of ten items was constructed as well as an attitude test of five items. Copies of each of the tests used can be found in Appendix A of the report. For two of the films, performance checklists were designed based upon the specific components of the tasks to be demonstrated, sawing and hammering. These two scales are also included in Appendix A of the report.

Statistical Analysis

To study the effects of hands-on experience on skill performance, t tests were used as well as analysis of variance to test the difference between the means by treatment group.

The second phase of the study concerned relationship between the variables. Pearson Product Moment Correlations were used to compare the relationship between knowledge, attitude and skill performance of the tasks chosen.

Factor analysis was used to explore the structure of the affective, cognitive and psychomotor skill variables.

Stepwise multiple regression was used to identify the variables which best predict the psychomotor tasks selected.

The affective, cognitive and psychomotor skill variables were broken down by grade, by sex, and by level of intelligence. Analysis of variance was first used to test whether the means were different and then Duncan's Multiple Range Test was used to identify between which groups there were significant differences.

All computations were performed on the IBM 370-45 Computer of the Computing and Data Processing Service of the University of Maine.

Other Instruments Used

Three tests were used to assess dimensions in the cognitive domain. The Lorge-Thorndike Intelligence Test (1966) which measures both verbal and non-verbal intelligence was used to measure the scholastic aptitude of the students.

The Iowa Test of Basic Skills (1971) was used as a measure of the student's school performance. The test measures reading vocabulary, reading comprehension, spelling, capitalization, punctuation, usuage, map reading, reading graphs, reference material skills, arithmetic concepts and arithmetic problem solving.

The Occupational Knowledge Test (1974) was used to assess the occupational knowledge of students in the experiment. The Occupational Knowledge is a revision of the Occupational Cognizance Test (Heath, 1969) made by LaMora (1974) for his dissertation. Heath developed eight forms of the test to measure the children's knowledge of occupations and their occupational educational expectations. The tests each contained twelve questions selected from among the following categories:

1. education and training required for specific occupations
2. nature of the work involved in specific occupations
3. recognition of the relationship of other occupations to a specified occupation
4. recognition of the field of work corresponding to a specified occupation

LaMora broadened the coverage of occupations used in the items to include a more proportional coverage based upon DOT categories and surveys on children's knowledge and interest on occupational fields.

Personality and Attitude Instruments

The Self-Concept and Motivation Inventory: What Face Would You Wear? (Milchus, Farrah, and Reitz, 1968) was used to measure academic self-concept. The test contains four scales, two for self-concept and two for motivation. The two self-concept scales are Role Expectations and Self Adequacy. Role expectations measures the positive acceptance of the aspirations and demands that the students think others expect of them. Self adequacy relates to the positive regard with which students view their present and future probabilities of success. These two scales are added and yield a total self-concept score. The two motivation scales are achievement needs and achievement investment. The former is the positive regard with which student perceives the intrinsic and extrinsic rewards of learning and performing in school. Achievement investment or failure avoidance measures the awareness and concern toward shunning the embarrassment and sanctions which are associated with failure in school. The two motivation scalesare added to give a total motivation score.

The School Sentiment Inventory (1972) is a publication of the Instructional Objectives Exchange. For the intermediate level there are 81 items in which students are asked to respond "true" or "untrue" to a series of statements regarding school. There are seven scales. Three relate to evaluation of the teacher: mode of instruction, authority and control and interpersonal relationships with pupils. The four other scales measure: students' attitudes toward learning, social structure and climate, peers, and general attitude toward school.

Learning Style

The Portable Rod-and-Frame Test (Oltman, 1968) was used to assess the cognitive style status. It was individually administered to the students. Cognitive style is a term utilized to describe pervasive and consistent modes that characterize how particular individuals come to know their world and how they organize and respond to their knowledge of it. Witkin (1962) describes two basic modes of information processing, field independence and field dependence. In brief, this refers to the tendency for one's perceptions to be influenced (FD) or not influenced (FI) by the context in which the stimuli are embedded.

RESULTS

Effects of Practice on Performance

The first research question was whether skill performance introduced by a film and followed by practice, hands-on experience, leads to better mastery of a psychomotor skill than when a film is presented without practice. The results of the t analysis for hammering and sawing skills are presented in Table 1.

Table 1

Comparison of the Means of Experimental and
Control Groups of 4th to 6th Graders, and 7th and 8th Graders
on Hammering and Sawing Skills

Skill	Group	Mean	Standard Deviation	df	t
Hammering					
Grade 4-6	Experimental	23.855	6.180	83	0.3794
Grade 4-6	Control	24.435	6.508		
Grade 7-8	Experimental	25.633	4.343	56	1.180
Grade 7-8	Control	26.893	3.735		
Sawing					
Grade 4-6	Experimental	20.120	4.676	87	2.3066*
Grade 4-6	Control	17.484	5.183		
Grade 7-8	Experimental	24.700	4.572		
Grade 7-8	Control	21.067	4.777	58	3.009**

* $p < .05$

** $p < .01$

There were no mean differences between the experimental groups who saw the film followed by supervised practice and the group who saw the film and did not have any practice at either the middle or upper grades. There were, however, differences on the means of the ratings of saw performance at both grade levels between the two groups. The difference was significant at the .05 level for the middle grade group and at the .01 level for the upper grade group. The groups receiving practice after the films scored higher ratings on the performance test.

Possibly no differences were evident on the hammering task since the task is a relatively simple psychomotor task whereas sawing is a more complex task which involves more motor skills and knowledge. Teachers utilizing films to introduce and teach more complex industrial arts skills may find immediate practice necessary for reinforcement of skills.

Effects of Instructional Strategy on Knowledge and Attitude

Two different instructional ways of presenting the films were used with the treatment groups in Grades 4 to 6. One group, the experimental group, had a class session, 40 minutes, to discuss shop safety before the use of the film and another session on selection of woods prior to the use of the films. The second group, the control group, was shown the film only. Both groups were given the knowledge and attitude tests after the showing of the films. The results of the comparison between means by the t test is presented in Table 2.

Table 2

COMPARISON OF THE MEANS OF EXPERIMENTAL AND CONTROL GROUPS OF MIDDLE GRADE STUDENTS ON KNOWLEDGE AND ATTITUDE TESTS

Area	Group	Mean	Standard Deviation	d.f.	t
Safety Knowledge					
	Experimental	7.954	1.924	88	1.8145
	Control	8.560	1.530		
Safety Attitude					
	Experimental	14.738	2.944	88	.6323
	Control	15.160	2.511		
Wood Knowledge					
	Experimental	4.560	1.502	87	2.1295*
	Control	3.828	1.443		
Wood Attitude					
	Experimental	13.219	3.658	87	1.0616
	Control	14.120	3.444		

* $p < .05$

There were no significant differences between instructional treatments on the safety tests and wood attitude test but significant difference at the .05 level on the wood knowledge test. Safety is a topic of concern to students in all grades and transfer may have taken place to applications within a shop. The film on wood knowledge was more complex and difficult for the sample. The group who were presented information about wood prior to the film knew more about what to look for in the presentation. The use of advanced organizers and behavior objectives in instruction help students focus attention on the required areas of knowledge. Attitude change demands a more complex instructional strategy and especially attitudes toward industrial arts objectives which are a part of a new experience for most students.

Levels of Intelligence, Knowledge, Attitude and Skill Performance on Selected Industrial Arts Objectives

The population of the study was divided into three groups based upon their verbal score on the Lorge-Thorndike Intelligence Test. The top group had above average IQ's, 111 and higher; the middle group had average IQ's, 90-110; and the lower group below average IQ's, 89 and below. The results of the comparison on the industrial arts variables are presented in Table 3. There were no significant differences between the means of the middle grade groups broken down by level of intelligence on any of the knowledge, attitude or performance skills tests. There were three significant differences between the means according

Table 3

Analysis of Variance of Selected Industrial Arts Variables for Middle Grade and Upper Grade Students by Level of Intelligence

Variable	IQ Group	Mean	Standard Deviation	df	F
Saw Knowledge					
Middle	Low	5.538	2.904		
	Average	6.676	1.701	2/72	1.7753
	High	6.692	1.784		
Upper	Low	7.500	1.829	2/46	3.5981*
	Average	7.118	1.900		
	High	8.556	1.149		
Saw Attitude					
Middle	Low	11.538	2.933	2/71	0.7424
	Average	12.029	3.362		
	High	12.808	3.406		
Upper	Low	12.714	4.340	2/46	1.2513
	Average	10.824	3.046		
	High	11.333	2.828		
Saw Performance					
Middle	Low	17.077	6.144	2/71	0.8459
	Average	18.735	4.712		
	High	17.346	4.409		
Upper	Low	23.071	3.583	2/46	1.8867
	Average	24.000	5.315		
	High	21.056	4.518		
Hammer Knowledge					
Middle	Low	6.167	2.443	2/71	0.5780
	Average	6.818	1.776		
	High	6.483	1.805		
Upper	Low	7.643	1.692	2/45	3.3167*
	Average	7.353	1.693		
	High	8.588	0.870		
Hammer Attitude					
Middle	Low	12.000	3.357	2/71	0.4063
	Average	12.909	3.166		
	High	13.103	4.161		
Upper	Low	12.857	3.207	2/45	1.8460
	Average	10.706	3.754		
	High	11.118	2.690		

Table 3 (continued)

Variable	IQ Group	Mean	Standard Deviation	df	F
Hammer Performance					
Middle	Low	25.750	5.242	2/71	0.4852
	Average	23.667	5.914		
	High	24.069	7.086		
Upper	Low	26.786	4.677	2/44	0.9641
	Average	26.750	4.683		
	High	25.000	3.162		
Safety Knowledge					
Middle	Low	7.154	2.882	2/72	2.2639
	Average	8.441	1.673		
	High	8.071	1.438		
Upper	Low	9.538	0.877	2/44	0.1692
	Average	9.375	0.719		
	High	9.444	0.705		
Safety Attitude					
Middle	Low	13.846	2.304	2/72	1.2578
	Average	14.735	2.666		
	High	15.321	3.111		
Upper	Low	15.846	2.734	2/44	0.9002
	Average	14.750	2.176		
	High	15.889	3.104		
Wood Knowledge					
Middle	Low	3.769	1.423	2/71	0.2844
	Average	4.088	1.443		
	High	3.852	1.680		
Upper	Low	4.385	0.961	2/44	3.7008*
	Average	4.500	1.592		
	High	5.556	1.381		
Wood Attitude					
Middle	Low	13.538	2.817	2/71	0.3980
	Average	13.912	3.241		
	High	13.074	4.385		
Upper	Low	14.077	3.685	2/44	2.1161
	Average	11.500	3.266		
	High	13.167	3.451		

* $p < .05$

to intelligence level for the upper grades on three of the four knowledge tests, saw, hammer and wood knowledge. The above average students have higher mean scores on the knowledge tests than the average or below average students. There are no significant differences between the means of the average and below average students. It should be noted that there are no significant differences on attitude or performance skill dimensions by intelligence level. Teachers can expect the brighter students to score higher than others on pencil and paper achievement tests; however, level of intelligence is not a factor in skill performance or attitude toward industrial arts activities. Teachers should guard about labeling students on the basis of IQ or having expectations or set that might influence lower or higher groups negatively.

Comparison of Sex Differences on Knowledge, Attitude and Skill Performance Tests

Comparisons of the means by sex were made on all of the scales for both the middle grade and upper grade groups. The results of the comparisons are presented in Table 4. There were sex differences on six of the ten measures at the middle grade level. Boys scored significantly higher than girls on saw attitude, saw performance, hammer attitude, hammer performance and wood attitude (all at the .001 level) and on saw knowledge (at the .05 level). There were no significant differences on safety knowledge, hammer knowledge, wood knowledge and safety attitude.

Table 4

t Tests of the Means of Selected Performance Skills, Cognitive and Affective Measures for Middle Grade and Upper Grade Students by Sex

Variable Group	Sex	Mean	Standard Deviation	d.f.	t
Saw Knowledge					
Middle	Male	7.073	2.005	85	2.2146*
	Female	6.152	1.873		
Upper	Male	8.067	1.780	58	1.7414
	Female	7.233	1.924		
Saw Attitude					
Middle	Male	13.488	2.942	84	3.93[illegible]9***
	Female	10.957	3.040		
Upper	Male	12.533	3.082	58	2.6988**
	Female	10.300	3.323		
Saw Performance					
Middle	Male	20.219	4.156	84	3.7869***
	Female	16.478	4.961		
Upper	Male	23.967	4.279	58	1.7107
	Female	21.800	5.461		
Hammer Knowledge					
Middle	Male	6.744	2.112	83	.8344
	Female	6.391	1.782		
Upper	Male	8.071	1.274	57	1.1964
	Female	7.613	1.626		
Hammer Attitude					
Middle	Male	14.410	3.050	82	4.5419***
	Female	11.304	3.217		
Upper	Male	12.643	3.423	57	3.4922***
	Female	9.774	2.883		
Hammer Performance					
Middle	Male	26.590	6.231	82	3.7760***
	Female	21.826	5.401		
Upper	Male	28.103	3.895	56	3.8867***
	Female	24.379	3.385		
Safety Knowledge					
Middle	Male	8.071	1.772	87	0.2469
	Female	8.167	1.906		
Upper	Male	9.069	1.132	55	2.9738**
	Female	9.750	0.441		

Table 4
(continued)

Variable Group	Sex	Mean	Standard Deviation	d.f.	t
Safety Attitude					
Middle	Male	15.476	2.865	87	1.9831
	Female	14.313	2.699		
Upper	Male	15.700	2.292	56	0.6067
	Female	15.286	2.891		
Wood Knowledge					
Middle	Male	4.293	1.309	86	1.5289
	Female	3.813	1.607		
Upper	Male	4.700	1.643	55	0.1782
	Female	4.630	1.305		
Wood Attitude					
Middle	Male	15.488	3.257	86	5.6795***
	Female	11.750	2.950		
Upper	Male	14.100	3.133	55	3.8350***
	Female	11.000	2.948		

* $p < .05$
** $p < .01$
*** $p < .001$

There were sex differences on five of the scales at the upper grade level. Boys had significantly higher mean scores on three of the attitude scales, saw attitude ($p < .01$), hammer attitude ($p < .001$) and wood attitude ($p < .001$). Boys also had higher performance ratings on hammer performance ($p < .001$). Girls had higher mean scores on the safety knowledge test ($p < .01$). There were no sex differences on the saw knowledge or performance tests, hammer knowledge, safety attitude, and wood knowledge skills.

There tend to be fewer sex differences on the knowledge scales and most differences on the attitude scales. Partly these differences may be due to role stereotyping. Earlier experiences with industrial arts programs and a career education program in the elementary grades may help to modify these attitudes. The lack of differences on the knowledge variables and, in one case, higher scores by girls again reflect traditional role expectations and higher achievement motivation on the part of girls.

Grade Level and Knowledge, Attitude and Skill Performance on Selected Industrial Arts Objectives

Comparisons of the variables by grade level were also made and reported in Table 5. There were significant differences by grade on three of the four knowledge tests, saw, hammer and safety. Students in the upper grades (8, 7, 6) scored higher than students in grades 4 and 5. There were significant differences only on one of the four attitude tests, hammer attitude. Students in the lower grades (4, 5, 6) had more positive attitudes than students in grade 7. There were significant differences between the performance ratings of students in the hammer ($p < .05$) and sawing tasks ($p < .01$). There were few significant differences on the

Table 5

Analysis of Variance and Duncan's Multiple Range Test of Selected Industrial Arts Variables by Grade Level

Variable	Grade	Mean	Standard Deviation	F	d.f.	Critical Diff Duncan's .05
Saw Knowledge	4	5.5333	1.8333	9.62**	4/143	
	5	7.0690	2.1865			8>4,8>7
	6	7.3103	1.4905			8>5,8>6
	7	6.9000	2.0060			6>4,5>4
	8	8.4000	1.4288			7>4
Saw Attitude	4	12.133	3.6928	0.66	4/143	
	5	12.138	2.9487			
	6	12.034	3.1564			
	7	10.967	3.3578			
	8	11.867	3.3808			
Saw Performance	4	16.033	4.3110	12.33**	4/143	7>4,7>5
	5	18.034	4.8586			7>6,8>4
	6	20.621	4.6323			8>5,6>4
	7	23.533	5.1175			6>5
	8	22.233	4.8472			
Hammer Knowledge	4	5.6207	2.0944	9.02**	4/140	8>4,8>5
	5	6.9643	1.9528			8>6,7>4
	6	7.1034	1.3455			6>4,5>4
	7	7.5000	1.6135			
	8	8.1724	1.2555			
Hammer Attitude	4	12.655	4.3118	2.71*	4/140	6>7,4>7
	5	12.643	3.1295			5>7
	6	12.966	2.9336			
	7	10.367	3.5862			
	8	11.931	3.1502			
Hammer Performance	4	22.931	6.2217	2.65*	4/139	8>4,8>6
	5	25.821	5.9694			
	6	23.448	6.2541			
	7	25.821	3.9068			
	8	26.633	4.2547			

Table 5
(continued)

Variable	Grade	Mean	Standard Deviation	F	d.f.	Critical Diff. Duncan's .05
Safety Knowledge	4	7.3438	1.7890	13.24**	4/143	7>4,7>5
	5	8.0000	2.0702			8>4,8>5
	6	9.1333	1.0743			6>4,6>5
	7	9.6552	0.5526			
	8	9.1429	1.1455			
Safety Attitude	4	14.781	3.7908	0.55	4/144	
	5	14.724	2.1530			
	6	15.100	2.1392			
	7	15.448	2.3541			
	8	15.552	2.8358			
Wood Achievement	4	3.9032	1.3001	1.81		
	5	4.0690	1.6676			
	6	4.1667	1.5105			
	7	4.5000	1.3744			
	8	4.8276	1.5827			
Wood Attitude	4	12.161	4.3901	2.43	4/142	
	5	14.034	2.8721			
	6	14.433	3.0136			
	7	12.571	3.8914			
	8	12.690	2.9167			

* $p < .05$
** $p < .01$

the less complicated hammer task but more on the more complicated saw task. Students in the upper grades (6,7,8) had higher ratings than students in grades 4 and 5.

Sawing is a more complicated psychomotor task and maturation is clearly an important variable. Attitude is relatively independent of grade level. Students in the upper grades have wider knowledge and greater attention span and task orientation than students in the lower grades. Teachers would need to use more physical and intellectual guidance to help younger students learn the more complex psychomotor skills and direct their attention to the important knowledge to be gained in the lesson.

Prediction of Skill Performance

The question that can be asked is what variables best predict skill performance. A stepwise multiple regression analysis was run to answer this question with hammer performance as well as saw performance. The results of the analysis of saw performance are presented in Table 6. Twenty-two independent variables out of the 27 tried were included in the analysis.[1] A multiple R of .884 was computed for these variables and accounted for 78.2 percent of the variance. The best single predictor of saw performance was saw attitude which contributed 13.99 percent of the variance. On the final step, five variables were significant at the .01 level and one at the .05. These were respectively saw attitude, wood attitude, sex, grade, age and general attitude. The second variable to be included was wood attitude which accounted for 11.67 percent of the variance. Sex contributed 10.91 percent,

[1] Five were rejected because the F-level or tolerance-level was insufficient for further computation.

TABLE 6

STEPWISE MULTIPLE REGRESSION ANALYSES FOR PREDICTING SAW PERFORMANCE OF ELEMENTARY GRADE STUDENTS, GRADES 4 TO 8, FROM SELECTED COGNITIVE AND AFFECTIVE VARIABLES

	Multiple R	R Square	RSQ Change	Simple R	B	F at Final Step
SAW ATTITUDE	0.37407	0.13993	0.13993	0.37407	0.97074	10.235**
WOOD ATTITUDE	0.50666	0.25671	0.11678	-0.13955	-1.11225	8.664**
SEX	0.60488	0.36588	0.10918	-0.22775	-3.97832	4.526**
SAFETY KNOWLEDGE	0.70276	0.49387	0.12799	0.20017	0.10495	.030
PEER	0.73133	0.53485	0.04097	-0.27530	-0.32263	.270
ROLE EXPECTANCY	0.75111	0.56416	0.02932	0.27051	0.11452	.189
GENERAL ATTITUDE	0.76603	0.58680	0.02263	-0.16746	-1.44999	2.559*
GROUP	0.77904	0.60690	0.02011	0.23389	0.95317	.240
GRADE	0.79510	0.63218	0.02527	0.24962	9.75496	5.816**
AGE	0.84786	0.71887	0.08670	0.03842	-5.68044	5.066**
SCHOOL CLIMATE	0.85405	0.72941	0.01053	-0.18501	0.75734	2.019
LORGE-THORNDIKE-VERBAL	0.86170	0.74252	0.01312	0.07711	-0.15243	1.686
LORGE-THORNDIKE-NONVERBAL	0.86626	0.75041	0.00788	0.12033	0.05570	.382
SAW KNOWLEDGE	0.87084	0.75837	0.00796	0.16875	0.23522	.154
ACHIEVEMENT INVESTMENT	0.87384	0.76360	0.00523	0.05933	0.14412	.526
MODE OF INSTRUCTION	0.87584	0.76710	0.00350	-0.23288	-0.40957	.623
INTERPERSONAL RELATIONS	0.87884	0.77236	0.00526	0.05149	-0.99830	.571
SELF ADEQUACY	0.88119	0.77650	0.00415	0.11059	0.14414	.232
COG STYLE	0.88345	0.78049	0.00399	-0.03102	0.01807	.353
FAILURE AVOIDANCE	0.88424	0.78188	0.00138	0.02214	-0.07362	.141
SAFETY ATTITUDE	0.88438	0.78213	0.00026	-0.02002	0.10064	.033
WOOD KNOWLEDGE	0.88454	0.78241	0.00028	0.16652	0.12024	.020
					36.50884	

* p .05
** p .01

Peer attitude from the School Sentiment Inventory 4.09 percent, and Role Expectance from the SCAMIN 2.93 percent. General Attitude from the SSI added another 2.26 percent. Group membership, whether the student had hands on practice or not, contributed 2.01 percent; Grade, another 2.32 percent. Age accounted for more variance, 8.67 percent. School Climate on the SSI and the Lorge-Thorndike verbal scale added each slightly over one percent of variance to the prediction of saw performance. The remaining variables showed a unique variance of less than one percent.

In analyzing the contribution of the various variables in predicting saw performance, affective variables such as industrial arts attitudes (saw attitude, wood attitude) accounted for 25.67 percent of the variance; physical factors such as sex, 10.9 percent of the variance; Maturational variables such as age and grade 11.19 percent of the variance; Attitude toward School, an affective variable (General Attitude, School Climate, Mode of Instruction, Interpersonal Relations), 4.5 percent of the variance. Scholastic aptitude (The Lorge-Thorndike Scales) added 2.1 percent of unique variance while self concept supplied 3.5 percent. Knowledge of industrial arts objectives (Safety and Saw Knowledge) contributed 13.5 percent.

The affective variables tend to be more important than the cognitive predictors in predicting saw performance. Maturational and physical factors also are important variables.

Teachers need to stress more the affective goals and possibly place less emphasis on the traditional cognitive components. In planning instructional sequences, the teacher needs to be concerned with the entry behavior or characteristics of the students such as their maturation and readiness.

Scholastic Aptitude as measured by the Lorge-Thorndike non-verbal scale represented 2.59 percent of the variance, Academic Self Concept variables combined, 1.82 percent.

Again maturational and physical variables need to be considered by the teacher when preparing an instructional sequence.

The instructional strategy used does make a difference in skill performance. "Hands-on" experience does aid the student in mastering a skill.

The teacher needs to be aware of the importance of the learning style of a student. Field independent students tend to prefer structured situations and are less socially concerned about the learning environment and tend to perform better on industrial arts activities.

Hammer Performance was the second skill to be analyzed. A multiple correlation of .9075 was achieved based upon the use of 22 out of the 27 variables entered. The results of the analysis are presented in Table 7. Five of the variables were not included because the F-level or tolerance level was insufficient for further computation. The variables accounted for 82.36 percent of the variance. On the final step, five variables were significant at the .01 level, sex, cognitive style, wood knowledge, hammer knowledge and instructional group. Seven were significant at the .05 level, wood attitude, safety knowledge, motivation score on the SCAMIN, safety attitude, the Authority and Control and Mode of Instruction scales on the SSI and the Lorge-Thorndike Non-Verbal scale. The first variable entered was sex which contributed 26.04 percent of the variance. Cognitive style added 15.59 more percent. The wood knowledge test had a unique variance of 7.47 percent. The instructional treatment of having "hands on" experience added an additional 4.76 more variance. Occupational knowledge and safety knowledge each had a three percent contribution.

In analyzing the variables, physical variables such as sex contributed the largest single amount of variance, 26.03 percent. A maturational variable such as grade was not significant and added less than 1% of variance. A learning style variable, cognitive style, contributed 15.58 percent of the variance. Field independent students tend to perform the skill of hammering better than field dependent students. Field independent students prefer to work in structured situations. Knowledge variables (hammer, wood, safety, and occupational) totaled 11.17 percent of the variance; attitude variables (wood attitude, SSI: General Attitude, Safety Attitude, SSI: Authority and Control, SSI: Mode of Instruction and Hammer Attitude, SSI: Interpersonal Relations) added 18.06 to the prediction of the skill of hammering.

TABLE 7

Multiple Stepwise Regression Analysis for Predicting Hammer Skill Performance of Grades 4 to 8 Students by use of Cognitive, Affective, and other Selected Variables

Variable	Multiple R	R Square	RSQ Change	Simple R	F at Final Step	B
Sex	0.51025	0.26036	0.36046	-0.51025	28.930**	-9.74911
Cognitive Style	0.64515	0.41622	0.16687	-0.40994	14.919**	-0.12958
Wood Attitude	0.70067	0.49094	0.07573	0.03018	3.318*	-0.66590
Wood Knowledge	0.72531	0.52607	0.04614	-0.02163	6.999**	-2.06931
Group	0.75747	0.57376	0.04769	0.06009	4.197**	3.52229
Occupational Knowledge	0.78295	0.61302	0.03925	0.14073	1.332	0.14939
Safety Knowledge	0.80542	0.64871	0.03569	-0.16026	2.234*	-0.85842
Interpersonal Relations	0.81911	0.67095	0.02224	-0.15039	0.481	-0.61805
School Climate	0.83694	0.70047	0.02953	0.15274	0.621	0.39918
General Attitude	0.84514	0.71427	0.01380	-0.07063	0.132	0.29253
Hammer Knowledge	0.85093	0.72409	0.00982	-0.00182	4.837**	1.66242
Total Motivation	0.85677	0.73406	0.00997	-0.02094	2.393*	0.35357
Safety Attitude	0.86459	0.74751	0.01345	-0.03546	2.727*	-1.01612
Authority and Control	0.87321	0.76250	0.01499	0.15234	3.694*	1.34888
Self Adequacy	0.87932	0.77321	0.01071	0.17264	1.499	-0.30783
Mode of Instruction	0.88573	0.78451	0.01130	-0.01921	3.051*	-0.85812
Lorge-Thorndike-Nonverbal	0.90027	0.81049	0.02598	-0.03979	2.700*	-0.12228
Learning	0.90309	0.81557	0.00508	-0.00920	0.838	0.78501
Role Expectancy	0.90514	0.81928	0.00371	0.19863	0.528	-0.20817
Failure Avoidance	0.90674	0.82218	0.00290	-0.06703	0.253	-0.14753
Hammer Attitude	0.90720	0.82302	0.00084	0.20200	0.064	0.08725
Grade	0.90756	0.82367	0.00065	-0.04417	0.059	-0.50818
						60.48129

Relationships Between Cognitive, Affective Skill Performance and Variables

The means, standard deviations, and Pearson Product Moment correlations between the knowledge, attitude and performance tests are presented in Table 8. The first comparison to be discussed is the relationship between attitude and knowledge. In three of the four direct comparisons (Saw Knowledge - Saw Attitude: Hammer Knowledge-Hammer Performance, Safety Knowledge-Safety Attitude; Wood Knowledge-Wood Attitude) the correlations were significantly different than chance. Two were significant at the .05 level, hammer knowledge and hammer attitude, wood knowledge and wood attitude while one was significant at the .001 level, safety knowledge and safety performance. The correlations show a low positive relationship between these categories of variables. This would indicate that there is not much relationship, little common variance, between knowledge and attitude on these variables.

The second comparison to be discussed is the relationship between knowledge and skill performance. A correlation of .2565 significant at the .001 level was found between saw knowledge and performance, while a correlation of .1194 was computed between hammer knowledge and performance. For the more complex task a low but positive correlation exists between knowledge and attitude indicating that there is a slight tendency for students who have more knowledge to tend to perform better.

The third comparison to be studied is the relationship of attitude to skill performance. There was a significant relationship between saw attitude and saw performance (.2206, $p < .01$) but not with hammer attitude and performance (.1248, N.S.). The relationship between saw attitude and saw performance is low but positive indicating that there is a slight tendency for students who perform better to have more positive attitudes and vice versa.

The next series question that can be asked are: What are the relationships between the four attitude scales? and What is the relationship between the two skill performance tests? There are six comparisons that can be made between knowledge tests. The correlations ranged from a high of .4721 between saw knowledge and hammer knowledge to a low of .2549 between wood knowledge and safety knowledge. Five of the six comparisons were significant at the .001 level, the lowest at the .01 level. The relationships were moderate but positive. The results would indicate that certain students tended to score consistently high on all tests, certain students consistently low. Possibly this is true of the student performances in other achievement areas in school too.

There are also six comparisons that can be made between the four attitude scales. All six comparisons are significant at the .001 level and range from a low of .3479 between hammer and safety attitude to a high of .6967 between saw and hammer knowledge. The relationship between the variables is substantial. Students who tend to have positive attitude toward one activity tend to have positive attitude toward all activities. Those having less positive attitude toward one activity tend to have it towards all the other activities.

Table 8

CORRELATIONS BETWEEN KNOWLEDGE, ATTITUDE AND PERFORMANCE
UNSELECTED INDUSTRIAL ARTS OBJECTIVES FOR STUDENTS IN GRADES 4 TO 8

Variables	Saw		Hammer			Safety		Wood		Mean	Stand. Dev.
	Attitude	Perf	Know	Att	Perf	Know	Att	Know	Att		
Saw Knowledge	-0163	2565**	4721***	0474	1561	4155***	0718	2999***	1644	7.075	1.860
Saw Attitude		2206**	2800***	6967***	0891	-0699	4297***	1321	5434***	11.824	3.304
Saw Performance			2737***	1033	3640***	2897***	1522	2451**	1952*	20.101	5.445
Hammer Knowledge				1760*	1194	4645***	2813***	3035***	3223***	7.075	1.860
Hammer Attitude					1248	-1005	3479***	1218	6105***	12.096	3.542
Hammer Performance						-0016	0519	1318	2279**	24.930	5.540
Safety Knowledge							2623***	2549**	1222	8.628	1.663
Safety Attitude								0679	5104***	15.114	2.732
Wood Knowledge									1787*	4.285	1.508
Wood Attitude										13.176	3.547

* p < 05

** p < 01

*** p < 001

The last relationship to be discussed is that between the two skills. The correlation between hammer and saw performance is .2565 ($p > .01$). The relationship is low but positive. There is a slight tendency for students showing skill in the one area to perform well in the other.

Factor Structure of Cognitive, Affective and Skill Variables

Another way of looking at the relationship between the many variables used in the study is through the use of factor analysis. Six factors were extracted with an eigen value of one or greater and these accounted for 89.4 percent of the variance.

The first factor accounted for 41.3 percent of the variance and had an eigen value of 8.520. Thirteen variables had loadings greater than .42. The factor is labeled scholastic achievement. The five subtests of the Iowa Test of Basic Skills had the highest loadings, all .8 or above. The variables and loadings are presented in Table 9. All of the knowledge tests for the experiment as well as the Knowledge of Occupations Test had moderately high loadings.

The second factor accounted for 17.0 percent of the variance and had an eigen value of 3.509. The variables with loadings of .4 and higher are listed in Table 10. The factor is labeled attitude toward industrial arts activities. The saw attitude, hammer attitude, safety attitude and wood attitude scales had loadings from a low of .619 for safety attitude to a high of .789 for wood attitude.

Table 9

Factor 1: Scholastic Achievement

Variables	Loading
Age	661
Grade	814
Saw Knowledge	525
Hammer Knowledge	567
Safety Knowledge	602
Occupational Knowledge	718
Lorge Thorndike Non-verbal	441
Vocabulary ITBS	895
Reading Comprehension ITBS	888
Total Language ITBS	877
Total Work Study Skills ITBS	927
Total Arithmetic	901

Table 10

Factor 2: Industrial Arts Attitude

Variables	Loading
Saw Attitude	764
Hammer Attitude	708
Safety Attitude	619
Wood Attitude	789

The third factor accounted for 13.3 percent of the variance and had an eigen value of 2.750. There were three scales that had significant loadings. These are listed in Table 11.

Table 11

Factor 3: Academic Self-Concept

Variables	Loading
Achievement needs	762
Role Expectancy	877
Self-Adequacy	771

Three of the four scales of the Self Concept and Motivation Inventory had high loadings on this factor.

The fourth factor is labeled scholastic aptitude and accounted for 6.5 percent of the variance and had an eigen value of 1.345. The scales with significant loadings are described in Table 12.

Table 12

F^ctor 4: Scholastic Aptitude

Variables	Loading
Lorge Thorndike Verbal	801
Lorge Thorndike Non-Verbal	793

The two subscales of the Lorge-Thorndike Intelligence Test contributed the largest amount of variance.

The fifth factor accounted for 6.3 percent of the variance and is described in Table 13.

Table 13

Factor 5: Attitude toward School

Variables	Loading
School Sentiment Inventory: Peers	505
SSI: Interpersonal Relationship w/ Pupils	440
SSI: Mode of Instruction	611

The three scales with significant loadings all are from the School Sentiment Inventory. The factor is labeled: Attitude toward School.

The sixth factor accounted for 4.9 percent of the variance and had an eigen value of 1.008. Only three variables had loadings of .40 or greater. These are listed in Table 14. Two of the variables are the skill performance variables. The factor is labeled skill performance.

Table 14

Factor 6: Skill Performance

Variables	Loading
Saw Performance	410
Hammer Performance	578
Sex	- 717

The seventh factor that accounted for 4.4 percent of the variance but had an eigen value of .9 was cognitive style. The learning style variable had a loading .820 on the factor and was the only one equal to or greater than .40.

In summary, the results tend to indicate that there are a number of separate dimensions that should be considered by teachers as well as researchers in the field.

These are as follows:

Scholastic Achievement

Attitude Toward Industrial Arts

Academic Self Concept

Scholastic Aptitude

Attitude Toward School

Skill Performance

Learning Style

The first factor extracted was an achievement factor which included the pencil and paper achievement scales both scholastic as well as relating to the industrial arts skills. Previous achievement as well as achievement in other subject areas tend to correlate together. Students who are successful academically in other areas tend to make the higher scores on traditional pencil and paper tests in industrial arts area.

The second largest factor was attitude toward the industrial arts objectives used in the project. It should be noted that this attitude cluster was more or less independent of general school attitude. No scales on the School Sentiment Inventory loaded on this factor. Teachers need to be concerned in developing and fostering attitudes toward their industrial arts program.

The third variable is also included in the Affective Domain, Academic Self-Concept. Developing and maintaining positive self concept of the student is also a necessary goal of the industrial arts teacher.

The fourth factor is the academic aptitude.

The fifth factor is attitude toward school and the sixth is skill performance.

It should be noted that knowledge, attitude and skill performance all have significant loadings on different factors. The teacher must recognize that there are different dimensions of the task and include cognitive, affective and psychomotor objectives in the units of study.

In analyzing the factors from another point of view, only two of the factors were from the Cognitive Domain or Intellective, academic achievement and academic aptitude. These factors accounted for 47.8 percent of the variance. Four of the factors extracted were from the Affective Domain: Industrial Arts Attitude, Academic Self Concept, Attitude Toward School, and Attitude Toward School Environment (not discussed in previous section because the factor had an eigen value less than one). The last area which contributed significant variance and would be classified in the psychomotor domain was skill performance which contributed 4.9 percent of the variance.

Summary of Statistical Results

The first research question was whether skill performance introduced by a film and then followed by practice, hands-on experience, leads to better mastery of a psychomotor skill than when the film is presented without practice. There were mean differences found both for the middle grade group and upper grade group on saw performance but not on hammer performance. The groups which had practice had higher mean scores than the groups who just saw the film and were tested.

Two ways of presenting the films were also tried. For two of the films, Selecting Wood and Shop Safety, one group was involved in group discussions prior to the use of the films while the other group was only shown the film. There was a significant difference on one of the tests, wood knowledge. The group who were presented information about selecting wood prior to the film knew more about what to look for in the presentation and had a higher mean score. There were no differences on the safety tests or wood attitude test.

The performance of the students on the knowledge, attitude and skill performance tests was studied by IQ level. There were no significant differences between the means of the middle grade groups when broken down by level of intelligence on any of the knowledge, attitude or performance skill tests. There were three tests where significant differences were found by IQ level for the upper grade students: saw, hammer, and wood knowledge tests. There were no differences on any of the attitude or skill performance tests for either group by IQ level.

The performance of the students on the three types of tests was studied by sex membership. There were sex differences on six of the ten measures at the middle grade level. Boys scored significantly higher than girls on the saw, hammer and wood attitude tests, saw and hammer performance and on saw knowledge.

There were sex differences on five of the ten scales at the upper grade levels. Boys had higher means than girls on hammer, saw and wood attitude and hammer performance. Girls had higher means than boys on the safety knowledge test.

The performance of the students on the three types of tests was compared also by grade level. Significant differences between the means by grade were found on three of the four knowledge tests (saw, hammer, safety). Students in the upper grades had higher mean scores than students in the lower grades.

There were significant differences between student performance on the two tasks by grade. There were few differences in hammer performance but marked differences on saw performance. Students in the upper grades had significantly higher ratings than those in the lower grades. There was a significant difference between the means by grade on only one of the four attitude scales. Students in grades 4, 5 and 6 had a more positive attitude on the hammer attitude test than students in Grade 7.

The second series of research questions concerned the relationship between the variables. First of all the relationship between knowledge, attitude and skill performance was studied. There were significant correlations between knowledge and attitude on three of the four variables. The correlations were positive but low. The second set of comparisons were between knowledge and skill performance. A significant relationship was found between saw knowledge and performance but not between hammer knowledge and performance. Again the relationship was positive but low. The third set of relationships were between attitude and skill performance. There was a significant relationship between saw attitude and performance but not between the two hammer measures. The relationship again was positive but low.

The factors which predict skill performance were identified through multiple stepwise regression. For predicting both saw and hammer performance twenty-seven independent variables were selected to be entered. A multiple correlation of .9075 was computed for hammer performance and .884 for saw performance. Five variables were significant at the .01 level in predicting hammer performance: sex, cognitive style, wood knowledge, hammer knowledge and instructional treatment. Seven were significant at the .05 level: wood attitude, safety knowledge, safety attitude, SCAMIN motivation, SSI Authority and Control and Mode of Instruction. Sex contributed 26.04 percent of the variance, cognitive style 15.5 and wood knowledge 7.47 and hands-on experience 4.76 percent. In predicting saw performance, saw attitude contributed 13.99 percent, wood attitude 11.67 percent, sex 10.91 percent, safety knowledge 12.79 percent, age 8.67 percent. Eighty-two percent of the variance was accounted for in predicting hammer performance and seventy-eight in predicting saw performance. Maturational, physical and affective predictors tended to contribute more unique variance than cognitive ones.

The commonality of the structure of the variables was studied by use of factor analysis. Six factors were extracted using the principal factor approach with orthogonial rotations with eigen values of one or greater which accounted for 89.4 percent of the variance.

The first factor was Scholastic Achievement which accounted for 41.3 percent of the variance. The second was Attitude toward Industrial Arts (17.0%); the Third, Academic Self Concept (13.3%); the fourth, Scholastic Aptitude, (6.5%), the fifth, Attitude toward School (6.3%); and the sixth, Skill Performance (4.9%).

Summary of Instructional Applications

Teachers utilizing films to introduce and teach more complex industrial arts skills may find immediate practice necessary for reinforcement of skills.

The use of advanced organizers and behavioral objectives in instruction help students focus attention onthe required areas of knowledge.

Attitude change demands a more complex instructional strategy, especially attitudes toward industrial arts objectives which are a part of a new experience for most students.

Teachers can expect the brighter students intellectually to score higher than others on pencil and paper achievement tests; however, level of intelligence is not a factor in skill performance or attitude toward industrial arts activities.

Teachers should guard about labeling students on the basis of intelligence or having expectations or set that might influence lower or higher groups negatively.

Earlier experiences with industrial arts programs and a career education program in the elementary grades may help to modify the sex differences in attitude toward the industrial arts activities.

Attitude toward industrial arts activities is relatively independent of grade.

Teachers need to use more physical and intellectual guidance to help younger students learn the more complex psychomotor skills and direct their attention to the important knowledge to be gained in the lesson.

Teachers should recognize the importance of maturational and physical factors in teaching strategies used.

Teachers need to stress more the affective goals and possibly place less emphasis on the traditional cognitive ones.

In planning an instructional sequence, the teacher needs to be concerned with the entry behavior or characteristics of the students such as their maturation and readiness.

The instructional strategy used does make a difference in skill performance. "Hands-on" experience does aid a student in mastering a skill.

The teacher needs to be aware of the importance of the learning style of a student. Field independent students tend to prefer structured situations and are less socially concerned about the learning environment and tend to perform better on industrial arts activities.

Knowledge and attitude are separate dimensions and are slightly correlated. Instructional strategies need to include sets of affective as well as cognitive objectives.

Knowledge and performance are only slightly correlated. Although there is a tendency for students who have more knowledge to perform better, teachers should not expect performance to appear automatically without sufficient practice.

Attitude and performance are just slightly correlated. Stress has to be placed upon both dimensions by teachers.

Teachers need to recognize that skill on one activity might not transfer to another one unless similar cognitive and psychomotor skills are evident. Teachers need to stress similarities and stress transfer of training.

Students who are successful academically, tend to make high scores also on knowledge tests of industrial arts objectives.

Attitude toward school and attitude toward industrial arts activities are independent or different dimensions. Teachers need to be concerned in developing and fostering positive attitudes toward their industrial arts programs.

The teacher needs to recognize that knowledge, attitude and skill performance are different dimensions as well as the self concept and learning style of the student. The teachers should make sure he makes a thorough analysis of the skills they are teaching as well as the characteristics of the students they have.

Developing and maintaining positive self-concept of the student is also a necessary goal of the industrial arts teacher.

Implications

Implications can be made from the results of this study for teachers and administrators and for curriculum or program:

Teachers

1. Practice or hands-on experience facilitates mastery of more complex skills.
2. Advanced organizers and/or behavioral objectives communicated to the students provide students the intellectual guidance they need in learning more complex information or tasks.
3. Films alone might lead to communication of certain types of information; however, films followed by practice better lead to mastery of more complex psychomotor skills.
4. Providing students advanced organizers or behavioral objectives prior to film presentation will lead to greater mastery of more complicated cognitive material.
5. Teachers who make task or goal analysis of what they are teaching and are able to identify the pre-requisite behaviors will have greater success in instruction.
6. The instructional strategies based upon the entry level of the students and their characteristics will be more successful.
7. Less mature students require more physical and intellectual guidance in learning complex tasks.
8. Affective variables such as attitude toward specific programs and general attitude toward school as well as self-concept are important variables in predicting a student's success in a program.
9. Stereotyped concepts concerning intelligence and sex role can interfere with teachin[illegible]ccess and student performance.

10. Learning style of the students needs to be considered in devising the instructional program.

Administrators

1. Homogeneous ability grouping is not necessary for industrial arts programs in the elementary grades.
2. Students can successfully perform industrial arts skills at early grade levels thatn the program is normally introduced.
3. School environment and climate are important variables in formulating student attitude and self-concept.

Curriculum

1. There should be affective goals and objectives stated as well as cognitive.
2. The suggested activities should take into consideration differences in learning style, readiness and other such factors.
3. Curriculum guides need to provide hands on experiences as well as illustrations to show the application of what is taught, where it can be transferred and how.

Recommendations

Recommendations from the results of the study are made for the State Department of Educational and Cultural Services, for pre-service and in-service education of teachers, for administrators, for curriculum development, and for further research.

State Department of Educational and Cultural Services

1. That the Department continue to sponsor research in the areas of learning strategies and teaching effectiveness.
2. That the Department sponsor workshops in understanding and writing objectives in the affective and psychomotor domains for teachers and administrators.
3. That the Department consider providing curriculum guides for the inclusion of industrial arts objectives earlier in the school program in order to help do away with sex stereotyping in educational and career areas.

Pre-service and In-service Education of Teachers

1. More emphasis needs to be placed upon the application of learning theory to classroom practices in pre-service programs.
2. Teachers need to have supervised experience in identifying, writing and utilizing objectives in the affective and psychomotor areas.
3. There needs to be more experiences arranged so teachers can translate theory into practice.
4. Teachers should have training in task analysis and systems approach to learning and teaching.
5. Teachers should become familiar with recognizing and identifying different types of learning styles and the prescriptive activities which best relate to these styles.
6. Teachers be given guidance to have repetories of activities that children can utilize to get "hands-on" experiences and be able to transfer what is learned.

Administrators

1. Administrators should support and participate in the in-service programs suggested.
2. They should support curriculum innovation and research.
3. They should recognize the importance of the school environment and pupil and public attitude toward school and provide the leadership to support a positive learning environment.
4. They should become familiar with writing performance objectives in affective, cognitive, as well as psychomotor areas.
5. They should give support to a program of career education with some laboratory experiences in the elementary grades.

Curriculum Developers

1. Curriculum materials should provide specific behavioral objectives, appropriate ones in all domains.
2. Different instructional strategies should be devised for students with different learning styles.
3. Suggestions for hands-on experiences, practice, and translation should be given.
4. Industrial arts objectives ought to be integrated in the curriculum prior to the upper grades.

Research

1. This type of study should be replicated on different types of populations; example: secondary students, vocational-technical students, etc.
2. Additional strategies should also be tested using other types of instructional media.
3. The effects of these experiences on immediate as well as delayed recall could be tested.
4. The relation of attitude to experience over time in industrial arts activities could be studied.
5. The relation to specific attitudes toward activities and general school attitude toward school and the school environment needs further research.

NAILS AND SCREWS

NAME ______________________ AGE __________ SEX __________

SCHOOL ______________________ GRADE ______________________

1. What type of nails are used when it is not necessary to conceal the heads?
    1. common
    2. finishing
    3. casing
    4. brads

2. What is the name of the unit used to describe the size of a nail?
    1. ounce
    2. pound
    3. penny
    4. inch

3. Which type of nail has the largest diameter?
    1. box
    2. common
    3. finishing
    4. casing

4. The part of the hammer used in pounding the nail is called
    1. the cheek
    2. the heal
    3. the head
    4. the face

5. The part of the hammer used in pulling nails is called
    1. the cheek
    2. the claw
    3. the head
    4. the face

6. In driving a nail, you should use
    1. many slow taps
    2. many fast taps
    3. a few solid blows
    4. a few light blows

7. If you want to insure that two pieces hold better together you should drive your nails
    1. straight
    2. at an angle
    3. in the same grain line
    4. completely through the two pieces of wood

8. If you wanted to increase the holding power of a small table you were building you should
    1. use common nails
    2. put in more nails than you would usually
    3. use screws
    4. use a nail set

9. To make screws or nails go into hard wood easier you should
   1. coat them with oil
   2. coat them with soap
   3. use a Phillip's screwdriver
   4. use a heavier hammer

10. The three parts of a screw are the
   1. cheek, head, toe
   2. heal, head, toe
   3. head, shank, thread
   4. head, cheek, thread

11. How do you like to work with nails and screws?
   1. not at all
   2. it is okay
   3. it is fun
   4. it is a lot of fun

12. How useful do you think it is to know about screws and nails?
   1. of no use
   2. of little use
   3. of some use
   4. of great use

13. Would you like to know more about types of nails and screws and how to use them?
   1. no, not interested
   2. not sure
   3. yes, I think so
   4. very much so

14. Are you planning to use either nails or screws in something you hope to make at home?
   1. no
   2. not sure
   3. probably yes
   4. definitely yes

15. Would you like to work in a job in which you would use nails and screws?
   1. definitely no
   2. not sure
   3. probably yes
   4. definitely yes

PERFORMANCE CHECKSHEET FOR THE HAMMER

NAME ______________________ AGE __________ SEX __________

SCHOOL ______________________ GRADE ______________________

1. PREPARATION FOR NAILING

1 ______ 2 ______ 3 ______ 4 ______ 5

carelessly determines where to nail

carefully determines where to nail

2. START OF NAIL

1 ______ 2 ______ 3 ______ 4 ______ 5

improper start

secures nail with a few short taps

3. MOVEMENT

1 ______ 2 ______ 3 ______ 4 ______ 5

uses improper movement

uses proper wrist, arm, & shoulder movement

4. ATTENTION

1 ______ 2 ______ 3 ______ 4 ______ 5

inattentive

keeps eye on nail

5. stroke of HAMMER

1 ______ 2 ______ 3 ______ 4 ______ 5

improper strokes

solid blows

6. GRASP OF HAMMER

1 ______ 2 ______ 3 ______ 4 ______ 5

improper grasp

proper grasp

OVERALL RATING OF PERFORMANCE

1 ______ 2 ______ 3 ______ 4 ______ 5

poor

average

excellent

SAW

NAME ______________________ AGE __________ SEX ______________

SCHOOL ______________________ GRADE ______________________

1. What kind of saw do you use when you want to cut across the grain of the wood?
   1. coping saw
   2. cross cut saw
   3. keyhole saw
   4. rip saw

2. What kind of saw do you sue when you want to cut with the grain of the wood?
   1. coping saw
   2. crosscut saw
   3. keyhole saw
   4. rip saw

3. The cut made by the saw is called
   1. the heal
   2. the kerf
   3. the teeth
   4. the mider

4. What type of saw has its teeth bent alternately right and left
   1. coping saw
   2. cross cut saw
   3. rip saw
   4. band saw

5. At what angle do you hold the saw when cutting?
   1. 10^{o}
   2. 25^{o}
   3. 45^{o}
   4. 90^{o}

6. What saw do you use when you want to make curved cuts and designs on thin boards?
   1. cross cut saw
   2. coping saw
   3. rip saw
   4. back saw

7. What is the small end of the saw called?
   1. heal
   2. blade
   3. toe
   4. teeth

8. If you want to saw something, the first thing you should do is
   1. get the different types of saws ready
   2. mark the place to be cut with a square and fine pencil
   3. wipe the saw with an oily rag
   4. saw with rapid strokes at a 90^{o} angle

9. When you start to make your cut, you should
    1. take short slow strokes with the heal of the saw
    2. take short slow strokes with the toe of the saw
    3. take fast strokes with the whole blade
    4. take slow strokes with the whole blade

10. When you are almost through the cut, you should
    1. make fast strokes with the saw
    2. make slower strokes with the saw
    3. cut from the other side
    4. change to a back saw

11. How do you like to saw?
    1. not at all
    2. it is okay
    3. it is fun
    4. it is alot of fun

12. How useful do you think it is to know about sawing?
    1. of no use
    2. of little use
    3. of some use
    4. of great use

13. Would you like to know more about types of saws and how to use them?
    1. no
    2. not sure
    3. yes, I think I would
    4. definitely yes

14. Would you like to take woodworking when you are in high school?
    1. no
    2. not sure
    3. yes, I think I would
    4. definitely yes

15. Do you plan to make woodworking a hobby or a career in the future?
    1. no
    2. not sure
    3. yes, I think I would
    4. definitely yes

CHECKSHEET FOR THE SAW

NAME ______________________ AGE ________ SEX ________

SCHOOL ______________________ GRADE ________

1. PREPARATION FOR SAWING

1	2	3	4	5
marks line carelessly with square			marks face as well as edge properly & carefully	

2. START OF CUT

1	2	3	4	5
makes several improper starts			starts correctly with heel of saw	

3. Grasp OF SAW

1	2	3	4	5
grasps saw improperly			has proper hand position	

4. STROKES WITH SAW

1	2	3	4	5
saws improperly			proper beginning, middle & ending strokes	

5. POSITION OF SAW

1	2	3	4	5
improper position and angle			proper angle and position	

6. STRAIGHTNESS OF CUT

1	2	3	4	5
crooked			straight	

7. OVERALL PERFORMANCE

1	2	3	4	5
poor		average		excellent

SAFETY

NAME ______________________ AGE __________ SEX __________

SCHOOL ______________________ GRADE ______________________

1. What type of clothing would be dangerous to wear in a shop?
   1. tie
   2. sweater
   3. short sleaved shirt
   4. apron

2. The most important product of the shop is
   1. finished wooden objects
   2. finished metal objects
   3. student achievement
   4. safety

3. The area around a work bench should
   1. be not marked because it is distracting
   2. open to observers as well as those working
   3. marked as an area for those individuals working
   4. close to other work areas

4. Which is not a characteristic of a safe shop?
   1. lumber stored in piles
   2. oily rags stored in cans
   3. people talking to their friends when they are working
   4. people wearing work aprons

5. It is essential in the shop to
   1. post safety records
   2. know safety rules
   3. use tools quickly so that others can use them
   4. know about the different kinds of wood

6. When using a hammer to pound a nail you should
   1. hold the nail with your fingers
   2. wipe the cheek of the hammer with an oily rag
   3. check the head of the hammer for dust and oil
   4. use rapid strokes

7. When using a chisel to cut wood you should
   1. cut toward you
   2. cut away from you
   3. cut sidewards
   4. cut using all three types of strokes

8. When carrying tools such as a chisel you should
   1. hold the point in your hand
   2. carry it in your pocket
   3. hold it in your fist horizontally
   4. hold the point down

9. If something is spilled on the floor you should
    1. wait and clean it up after class
    2. wipe it up immediately
    3. tell the shop teacher you spilled something
    4. do not worry about it

10. Safety is primarily the responsibility of
    1. the school district
    2. the teacher
    3. the principal
    4. the shop student

11. Safety is just as important at home as in school and shop
    1. definetly no
    2. not sure
    3. probably yes
    4. definitely yes

12. How useful do you think it is to know about shop safety
    1. of no use at all
    2. of little use
    3. of some use
    4. of great use

13. Would you like to have more discussion on safety in other classes
    1. no
    2. not sure
    3. yes
    4. definitely yes

14. Would you tell another student he should be careful if he were doing something that was unsafe in shop
    1. no
    2. not sure
    3. probably yes
    4. yes

15. Would you like to take shop courses in the future?
    1. no
    2. not sure
    3. probably yes
    4. definitely yes

WOOD

NAME ______________________ AGE ________ SEX ________

SCHOOL ______________________ GRADE ________

1. Wood that is cut tangent to the annual rings is called
   1. plain sawed
   2. rough sawed
   3. quarter sawed
   4. whole sawed

2. What type of cut is less likely to split?
   1. plain sawed
   2. rough sawed
   3. quarter sawed
   4. whole sawed

3. Wood cut in thin sheets is called
   1. dressed lumber
   2. dimension lumber
   3. worked lumber
   4. vaneer

4. What type of lumber is 2 to 5 inches thick and 2 or more inches wide
   1. board
   2. dimension
   3. timber
   4. post

5. Wood is classified by all of these <u>except</u>
   1. by tree
   2. by processing
   3. by size
   4. by color

6. When lumber is machined to smoothness and desired dimensions it is called
   1. rough
   2. dressed
   3. worked
   4. vaneer

7. Molding is sold by
   1. board foot
   2. linear foot
   3. both board and linear foot
   4. none of the above

8. How many board feet does a 2" x 4' x 6' board contain?
   1. 2
   2. 4
   3. 6
   4. 8

9. Which of the following woods would be best to use to build outside patio furniture?
   1. redwood
   2. walnut
   3. white pine
   4. birch

10. Which of the following woods would be best to use to build kitchen cabinets?
    1. redwood
    2. walnut
    3. white pine
    4. birch

11. How useful do you think it is to know about woods?
    1. of no use
    2. of little use
    3. of some use
    4. of great use

12. Would you like to know more about types of wood and how to use it?
    1. no
    2. not sure
    3. yes, I think I would
    4. definitely yes

13. Do you like to work with wood?
    1. no
    2. not sure
    3. sometimes
    4. yes, I would like to spend more time at it

14. Are you planning to use wood in some kind of project you hope to do at home in the near future?
    1. no
    2. have nothing planned
    3. yes, hope to use some
    4. definitely yes

15. Would you like to do woodworking as a career or hobby?
    1. no
    2. not sure
    3. yes
    4. definitely yes

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